Methodological Needs and Behavioral Research with Child Dental Patients

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The National Consensus Development Conference on Anesthesia and Sedation in the Dental Office noted that "behavioral approaches are often overlooked as effective mechanisms for relieving patient apprehension," and suggested that sedation and general anesthesia may be unnecessary in situations when psychological approaches are effective.[1] The problems in getting dentists to consider this alternative may include: limited training received by dentists and dental personnel in behavioral management; time and cost-effectiveness considerations; and methodological shortcomings in research designed to demonstrate the relative efficacy of psychological rather than pharmacological approaches or when they should be combined. This paper will attempt to pinpoint the methodological problems in this area of research and identify future research needs. Hopefully, the widespread use of sedative agents with child dental patients[2] will be reconsidered if dissemination of research findings on efficacy of behavioral intervention includes clinically significant measures and practical considerations which can be incorporated into general office practice.

The organization of this paper will include a definition of the measurement problems, identification of risk predictors, and methodological considerations for outcome studies.

Defining and Measuring Anxiety

A reliable way to measure anxiety is a prerequisite for the evaluation of intervention. There have been arguments that criteria for child compliance in the dental chair is not well specified.[3] Concern for childrens' safety during dental procedures such as injection of local anesthetic dictates that sitting quietly in the chair with the mouth open is an important part of the definition of compliance. Yet studies argue that the child who sits in the operatory with white knuckles and heart palpitations may be dental avoidant in the future.[4,5] Most youngsters adapt well just by repeated exposure in the dental setting and familiarity with instruments, personnel, and procedures.[6,7] However, children who have had negative experiences during dental treatment are likely to be at greater risk for anticipatory anxiety and possible development of dental phobia as adults.[8] The efforts of researchers, both psychologists and dentists, in defining measures of dental anxiety in children will be reviewed in terms of both practicality and validity. The lack of comparability of measures in sedation and behavioral intervention studies have limited the comparison of their relative merits. The need for a measure of the dentist's anxiety or amount of time required to support a difficult patient is a necessary additional consideration. Individualization of both the assessment of risk factors for disruptive behavior and intervention techniques should lead in the direction of prevention of fear rather than rehabilitation.

Fear is defined by the verbal expression of pain or discomfort, the behavioral expression of avoidance or interference with treatment, and the autonomic arousal that may accompany a stressful experience. These three types of indices of anxiety do not necessarily vary together.[9,10] The degree to which one values one index over another may depend upon their perspective. For the child patient, the subjective experience of fear may cause increased expectations of pain, may lead to disruption of dental procedures, and may elicit uncomfortable visceral reactions, such as sweating or heart palpitations. For the dentist, the primary target is often complaint behavior in the chair which facilitates the speed and quality of dental care. For the anesthetist or dental surgeon, the autonomic indices, including blood pressure and respiration, are used to determine the need for more or less sedation

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or analgesia. The child's reports of tingling sensations, euphoria, and unobstructed airway may be indicators of level of sedation. For the mother, sometimes fear of embarrassment for their children's disruption is a primary concern. Parents who are dentally phobic themselves may expect the child to behave poorly and may nonverbally communicate their own agitation. Therefore, in order to undertake appropriate intervention it is important to consider a broad range of measures.

Self-Report of Subjective Anxiety

In adult patients the self-report of fears has been found to discriminate between high or low dentally anxious patients in terms of avoidance or distress behaviors.[11,13] However, children's self-ratings of dental fear are not as reliable an indication of their fears as their actual behavior in the dental setting.[14,15,16] In evaluating either behavioral or self-reported fear, the measures must be age appropriate. Younger children typically report more fear regardless of the situation, whereas older children inhibit the behavioral expression of fear or pain. Younger children are more likely to show anxiety at separation from the parent, whereas the older child may anticipate punishment or criticism of emotions. Girls are more likely to verbally express pain and fear than boys. Pain threshold measures, while available for use with adults with the contributions of Dworkin and Klepac and their colleagues, are not developed for child patients.

The range of self-report measures of children's anxiety before or during treatment include drawings,[17] selecting smiling or sad faces,[18] or responding to questionnaires.[19] The measures must demonstrate reliability in scoring, test-retest reliability, and be valid with respect to correlating with other indices such as behavior during treatment, dentists' ratings of cooperation, mothers' expectations of behavior and/or physiological arousal. Cuthbert and Melamed,[19] for instance, demonstrated that when mothers administered the Children's Dental Fear Survey to their 4– 14-year-old children, those reporting higher scores showed more disruption during restorative treatment and were reportedly showing more general problem behaviors. There were age trends consistent with other surveys that 7–9-year-old youngsters have the highest fears and/or present more management problems. It has also been reported[20] that it is with this age groups, especially girls, that the dentists are most likely to have intravascular penetration accidents during administration of local anesthetics.

Measurement of subjective discomfort must be sensitive to changes over time. In the process of coping with an upcoming fearful event an elevated rating of arousal may be adaptive and help the child prepare for sitting still. It is not unusual for the child to report a reduction in fear after the treatment is finished. Therefore, in comparing studies since the timing of measurement may have influenced the results, rather than treatment efficacy, standardization of assessment periods over the course of the treatment and follow-up is advised. A no-treatment control condition allows for the evaluation of the repeated measurement.

Behavioral Measures

Rating scales which employ independent observations of childrens' behavior during treatment are available for children as young as 36 months of age,[21,22] preschool,[23,24] and for school-aged youngsters.[25,27] Behavioral measures for assessing the need for a level of sedation or analgesia have included airway obstruction,[26,28] tickle proneness,[29] play behavior,[30] behavior checklists,[31] and global rating scales.[32]

These scales have differing degrees of validity and choice of instrument has been largely made based on the degree of precision regarding parametric quantification or evaluator's needs. For instance, the tickle test was a quick and easy method for predicting the dentist's use of local anesthetic in 6- to 14-year-old children. The observation that children who avoid dental toys in the waiting period have more difficulty during restorative treatment may focus attention on the usefulness of this waiting period as an observational setting. Mother-child interactions during the anticipatory period have also been found to relate to children's medical distress.[3] Issues of practicality have also been raised in relation to a simple dichotomous rating versus more sophisticated observational recording including videotapes. The need for a quick indication of obstructiveness as it relates to the need for more sedation was defined by Lindsay and Roberts.[34] Some investigators including Weinstein and his colleagues [5,27,35] and Melamed and her colleagues[4,25] prefer videotaping the entire dentist-child interaction so that accuracy can be obtained in rater reliability and to enable complex chains of behavior to be coded that may illuminate cause and effect relationships in the behavioral interaction. For instance, prior to loud screaming, it was noted that nonverbal distress increased and patient silence declined.[27] The choice of differing measures from one study to another complicates comparability.

Physiological Results

Researchers have made a consistent effort to include information about the arousal of the child. Today with the growing interest in the interface of pharmacological and behavioral research, this is an even more important consideration. Physiological arousal is always altered by the administration of a drug and the state of arousal often influences a patient's response to sedation. The patients' detection of heart rate increases and sweating may lead them

to label their emotions as fear. The continuous monitoring of patient physiology is mandatory during use of sedation analgesia. The biofeedback technology has made monitoring of psycho-physiological stress measures, including pulse rate, respiration, and sweating, inexpensive and unobtrusive during routine restorative treatment.

The research precedent for physiological monitoring during routine dental practice dates back at least to 1958, when Lewis and Law[36] showed that heart rate was a useful and valid measure of transient stress during dental treatment. The difference in heart rate change and variability in children inexperienced in dental treatment when compared with those experienced in the procedures also provides validity.[37] In looking at the process of dental treatment, investigators[38,41] have found that heart rate reflects adaptation across treatment sessions and discriminates the high from low stress procedures. Heart rate deceleration, indicative of information processing however, during the observation of a peer model receiving local anesthetic, was related to information obtained and lowered disruptiveness during actual dental treatment.[42]

The Palmer Sweat Index has been used to discriminate the prepared from unprepared child patients pre- to posttreatment.[43] Respiration rate was found to vary with treatments explicitly training the patient in controlled breathing.[44,45] Saliva cortisol levels and plasma cortisol levels have yielded inconsistent results in predicting the need for general anesthesia.[46,47]

Interaction Measures

Patient-Dentist

Interaction between the patient and dentist has been found to predict fearful children. The dentist's anxiety as revealed by their management, physiology (i.e., heart rate, sweating), or confidence has been found to elicit children's disruption during routine dental restoration.[4,35]

Mother-Child

The mother-child interaction in the treatment waiting room has been found to relate to children's behavior during the physician's examination.[33] Mothers who cannot effectively coach their children may transmit their anxiety nonverbally as well as directly.

In summary, there is a large battery of measures which can be employed in understanding dental fear. The current statistical advances make it possible to do a profile analysis of concordance and desynchrony between these different measures of arousal. Multiple repression techniques allow us to evaluate which measures most strongly predict which behaviors. The use of time series sequential analysis allows us to examine causal relations between behaviors of the practitioner and patient.

It is difficult to say which measure is most important. In evaluating different therapeutic interventions one should select a measure which would be expected to relate to the system being altered. For instance if biofeedback, drugs, or relaxation procedures are being evaluated, attention to the physiological system may make the most sense. It may be that in order to achieve the most long-lasting therapeutic effectiveness, combinations of approaches can be employed, necessitating multidimensional assessment. Self-reported reduction of anxiety often lags behind the other changes.[48] It is therefore important to consider the timing of the assessment in order to evaluate the dynamic process of change.

The Need to Identify Predictors for Children at Risk

Maternal Predictors

We have found that mothers' reports that they tend to punish their children's fear behaviors and that they expect their children will have difficulty with dental treatment, are highly related to actual disruption during dental treatment.[49] Although many studies have attempted to reduce children's anxiety by reducing mothers' anxiety, there is not a one to one relationship between mothers' anxiety and children's behavior, particularly after the child has had more than a single restorative session.[6,50] Mothers have generally been excluded from the dental operatory, except with very young children, in an effort to reduce possible child disruption. However, support for evaluating the presence or absence of the mother on children's anxiety stems from Venham, Bengston, and Cipes.[5] Systematic studies of the effect of mothers' presence on children's reactions to dental treatment may reveal much about the development of children's fears and may lead to a more effective way of teaching mothers and children to cope with stressful situations. The age of the child and the behavior of the mother in the actual situation need to be studied. We have developed a Dyadic Prestressor Interaction Scale[52] and have found that the interaction between the mother's response, particularly agitation, varies with her state anxiety and directly affects the child's distress. As Winer[53] suggested, studies of the development of dental fears need to take the childrens' age and cognitive abilities into account. We found that mothers' use of distraction, information provision, and reassurance as it co-occurs with her agitation, ignoring or restraining behaviors varies with the children's age. Mothers tend to distract younger children and provide more information. Lag sequential analysis techniques have allowed us to further specify the direction of these effects as to their causal nature.[54] Figure 1 demonstrates that the degree to which

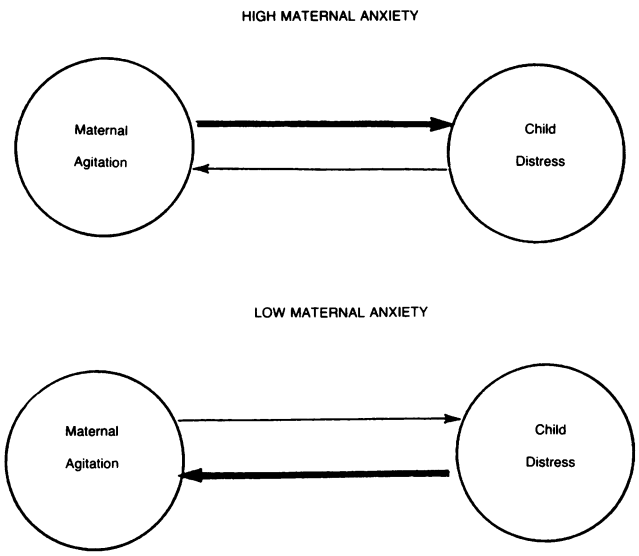

Fig. 1 —Effect of maternal self-reported state anxiety on the sequential relationship between maternal agitation and child distress. Heavy arrows represent statistically significant increases in the conditional probability of the behavior at the head of the arrow, given prior presence of the behavior at the tail of the arrow. The light arrows indicate a lack of significant conditional probabilities between the behavior and prior presence of the other behavior.

mothers exhibit agitation when they report high-state anxiety more likely leads to children's distress during outpatient pediatric clinic visits. Further work in this area within the dental setting would help us understand how to make better use of the parent, and how to detect children who may need more help because they have not learned how to cope with stress.

Child Predictors

Previous Experience

Early experience has clearly been implicated in the development of dental anxiety. Venham and his colleagues[41] have studied children from initial visit to subsequent visits using a broad range of physiological, anxiety ratings, personality and developmental tests. The results suggest that dental anxiety is a dynamic phenomenon, which evolves in a complex and variable manner as dental experience accumulates. It is clear that young children bring to the initial dental experience internal characteristics (passive withdrawal, difficult temperament, pessimism, high neuroticism) that may facilitate or impede adaptation to the dental stress. A multitude of factors — including early experience, family attitude, and dispositional variables — appear to interact to determine the child's initial level of situational anxiety. The course and content of the dental experience may, then, exert a significant influence on the child's concomitant fear response. Despite many studies reporting different levels of therapeutic effectiveness depending upon the children's previous treatment experience,[42,55] there is a serious need for a measure to be developed which will reflect the level of experience and quantify the negative effects of previous treatment. Perhaps a composite rating based on actual conditions and nature of the treatment procedures (extraction, abscess), dentists' assessment of the child's adaptability, and a behavioral index could be kept on every child who undergoes routine treatment. We have developed standardized indices for oral hygiene, plaque, etc.: this new measure is important for the continued understanding of the development of dental anxiety.

Age Appropriateness

Younger children are generally more upset by and cooperate less with medical and dental procedures[32,56] and report greater medically related fears if prepared one week in advance.[57] In addition to previous experience, age has been found to interact with type of dentist management or preparation in predicting effectiveness.[4,42] It has been shown that for children under eight years of age, particularly for those who have had negative previous experience, the presentation of information packets may even sensitize them prior to restorative treatment or surgery.[42,58] This effect may be due to the re-invoking of the emotional concomitants conditioned to the fearful situation. Younger children retain less information than older children.[31,59] It has also been found that unpleasant experience with injections or surgery may bring the child into the dental situation with greater anxiety.[60] Therefore, intervention studies must evaluate the child's age, coping repertoire, and level of initial dental fear as they interact with the effectiveness of preparatory information. If information is presented when the child's level of arousal is too high it is unlikely to be processed effectively.[61]

Intervention-Methodological Considerations

Subject Characteristics

The lack of comparability of heterogeneous samples of children included makes it difficult to compare across research studies to determine the most effective treatment strategies. While randomized assignment is often encouraged to control for such variation, it seems more important to match groups in terms of age and previous experience so that these influences can be analyzed. Including children with special handicaps or medical problems may complicate the interpretation of data on management problems. as these may stem from physical more than psychological factors.

Outcome Measures

A standardization of outcome measures would facilitate between-subject comparisons. There exists a large range of dependent measures which have demonstrated reliability and validity within the dental setting. The use of multivariate techniques could allow for the evaluation of factors which may contribute to the prediction of favorable outcomes. The covariation among measures and across time periods of assessment would allow a better understanding of fear modification.

Component Analysis of Treatment Packages

In order to evaluate the effective ingredients of intervention, a greater specification of mechanism needs to be made. The comparison with traditional treatment, sedation use, placebo drug, expectancy factors of both child and dentist, needs to show the cost effectiveness of the psychological intervention. Theoretical predictions must include specifying differential effects depending upon the age, previous experience, and coping abilities of the patient. The question of who is at risk for problems must be followed by which methods would be most useful for which patients, and delivered by which professionals?

During the early evaluation of treatment it is important to use double-blind procedures, where the dentist is unaware of which preparation, if any, the child received. Studies have shown that the dentists' preference will often affect the decision made regarding effective treatment strategy.[34] The expectancy of drug effects by the patient influences the potency of the sedative or analgesia.[62] Dentist's choice of treatment of sedation needs to be tailored to the patient. For instance, teenagers who reported effective nitrous oxide sedation, actually preferred local anesthetic alone on the subsequent treatment session.[63] Given the problems associated with teen-age drug abuse, a more conservative nonpharmacological approach may be indicated. The dentist's use of punishment-oriented procedures, including loud voice, criticism, physical restraint, or hand-over-mouth may be based on practical experience. Given that these may only have short-term effects, dentists should be trained to use other contingency management procedures and provide for the comparative analysis of different reinforcement strategies.

The need to do follow-up studies of treatment effectiveness is based upon studies which show that just repeated experience with restorative treatment itself reduces fear and improves cooperation, while others demonstrated sensitization effects of preparatory procedures. The only long-term follow-up study is retrospective in nature.[64] It demonstrated that a 15-minute cognitive-behavioral program, used with children who were previously untreatable by their dentists, showed 78% maintained positive acceptance of dental treatment five years later. Longitudinal or prospective research needs to be undertaken in order to evaluate risk predictors and age effects related to dental fear.

Context /Environmental Variables

The time for treatment is critical to the efficiency of dental practice. The waiting room can be used to screen for dentally fearful patients. Mother-child interactions, play behavior and the actual length of time preceding the appointment, may influence the child's behavior in the operatory. The friendly interaction of the child with office and dental personnel has been found to be a potent reducer of anxiety[65] and should not be underestimated.

Summary and Directions for Future Research

The field has moved in the direction of preventive dentistry. Certainly the effectiveness of the caries-prevention effort with fluoridation will likely lead to a generation of children with less aversive restorative treatment experiences.[66] The improvements in service delivery and the reduced anxiety of future parents may lessen the need for psychological intervention with most child dental patients. The need therefore, should be for the developing of cost-effective treatment packages focused at identifying those individuals who do need psychological intervention. Follow-up studies are necessary to assess the lasting effects of intervention and its influence on future health care utilization. Preventive stress inoculation can be undertaken with children who have poor coping skills. The evaluation of parent-child and parent-dentist-patient communication as it affects coping behavior is necessary. Predictor factors are available. An objective universally adopted measure of patient's treatment experience would help specify the effects of previous experience. Dissemination of contributions by pharmacology, psychology, and other disciplines can only be achieved by the development of a common language and acceptance of objective measurement system. The tools are available for measuring anxiety through many systems including behavioral, physiological, and subjective experience. Multidimensional measures are recommended particularly when multimodal treatment packages are evalauted. Standardization of times of assessment would allow for the analysis of the process of treatment as it influences fear. The adaptation of these for use in dental practice requires that the curriculum of dental students include behavioral science information on the importance of these factors in helping the dentists gauge the specific needs of these individual patients, rather than routinely using psychosedation or assuming that all patients need help in dealing with discomfort of dental treatment. Patients' self-esteem

often depends upon their own ability to handle their discomfort. Double-blind studies should be conducted where dentist and patient expectancy of drug or behavioral effects are evaluated. We need to compare the relative efficacy of pharmacological and behavioral methods using similar outcome measures. The media unfortunately will likely lag behind, and the image of the dentist as a caring partner in health promotion may await the implementation of anxiety-reducing procedures with phobic patients.

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Pharmacologic Research and Methodologic Needs for Child Dental Patients

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The 1985 NIH Consensus Development Conference "Anesthesia and Sedation in the Dental Office" attempted to define the state of the art in dental anesthesia.[1] The consensus statement generated by the panel was that the "available evidence" suggests sedation and anesthesia to be relatively safe but, due to the paucity of available data, conclusions regarding the most effective therapies are not always possible. As a pharmacologist and a member of the dental profession who is closely involved in dental anesthesia teaching, research, and practice, I would like to briefly review the research needs in the field of pediatric sedation and anesthesia.

Behavioral pharmacology at its most basic level

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